

THE ZOO GOER

M.
WINSLOW

Volume 1, Number 6

February/March 1973

Price .50



Published by the Friends of the National Zoo



Published by
 Friends of the National Zoo
 National Zoological Park
 Washington, D.C. 20009

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Special thanks to Dr. Helmut K. Buechner, Smithsonian Senior Ecologist, for photographs on pages 21 and 23. Front and back cover photos and photos on pages 3 and 19 by Margaret White. Photograph on page 5 by Dick Hofmeister. Photograph on page 8 by Donna Grosvenor. Photograph on page 10 by W. K. Howser. All other photos by Cathy Rasenberger.

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A Tree
Kangaroo
In The Pouch

On October 31st, 1972, keepers at the Lion House (*number 23 on map*) noticed that one of the female Matschie's tree kangaroos on exhibit there had an infant in her pouch. The infant — or "joey" as the young of kangaroos are called in the Australian vernacular — was then still in an extremely undeveloped state. Gradually, as weeks went by, the bulge in the mother's pouch became obvious; and by the middle of December the infant had begun to put its head out of the pouch occasionally. In addition, another of the Zoo's female tree kangaroos gave birth in late December or early January.

Young of this species — like the young of other species of the kangaroo family — are blind, deaf, and entirely hairless at birth. Weighing only a fraction of an ounce, they are in an almost completely embryonic stage of development. Only a pair of very muscular forearms, strong claws on each of the five fingers of the hands, and a keen sense of smell are notably developed; and it is on these three comparatively well-developed characters that the newborn tree kangaroo must rely to find its way from the vaginal opening into the pouch. It must make this journey entirely without aid from its mother, hoisting itself along through her fur by means of its forepaws only. At birth its hind limbs are still much smaller than the forelimbs and lack any claws, and the infant must evidently rely solely on its sense of

smell to direct it to its eventual goal — a nipple inside its mother's pouch to which it will attach itself for the next several months of its life.

Once inside the pouch, the joey takes hold of one of the four teats with its mouth. The teat swells up inside the mouth so that it would be difficult to remove the young kangaroo without causing injury to it and to its mother. While the infant is in the pouch, the mother must clean the inside of the pouch regularly with her mouth in order to remove the infant's waste products. As she does so, she often holds the pouch open with her forepaws. Observing such behavior on the part of a female kangaroo is one of the ways zookeepers have of telling that she has an infant in the pouch before the infant is large enough to produce a noticeable swelling.

The Zoo's tree kangaroos belong to a species known as Matschie's tree kangaroo (*Dendrolagus matschiei*) which is native to eastern New Guinea. This is one of five species of tree kangaroo, all members of the genus *Dendrolagus*; two of these occur on the Australian continent, and three are found in New Guinea. This distribution may seem somewhat problematic until one realizes that during the Pliocene epoch of the earth's history, which lasted from ten million years ago to about one million years ago, New Guinea was connected by a land bridge to Australia. And it is believed that it was





sometime towards the close of the Pliocene that the *Dendrolagus* line clearly differentiated itself from the more typical, terrestrial branches of the kangaroo family. (The parma wallabies that share the tree kangaroo's enclosure at the Lion House are good examples of the terrestrial kangaroos.)

Moreover, the northern Queensland areas where tree kangaroos are found are ecologically quite distinct from the rest of Australia. That island continent is characterized by its arid open areas and its temperate climate, but on its northern coast there are tropical forests that are quite reminiscent of the tropical forests that dominate New Guinea. In fact, the tree kangaroos are only one of several unique groups of animals that are limited to both of these forested areas. Another group of arboreal marsupials, the cuscuses (genus *Phalanger*), are also found only in New Guinea and in the forests of Northern Australia, as also are the large flightless forest birds known as cassowaries. (The National Zoo has four double wattled cassowaries, located behind the Bird House, *number 6h on map*.) It is theorized that when New Guinea was connected to Australia, it was the abundant fruit and leaves in this same sort of tropical forest that led the ancestors of tree kangaroos to abandon the terrestrial grazing habits they shared with the kangaroos of the open country to the south and experiment with an arboreal life.

Interestingly, it is believed that the original ancestors of all kangaroos were arboreal; like

the opossum, they seem to have had prehensile tails and big toes adapted for grasping branches. The kangaroos lost these features when they adapted to life on the ground; and, in what was in effect a return to the trees, the tree kangaroos did not regain them. In fact, the tree kangaroos succeeded in accomplishing the shift in ecological niche with relatively little modification of the basic kangaroo structure.

The tail, of course, changed somewhat. No longer used as a prop or "third leg" in the typical kangaroo fashion, it has taken on a new kind of balancing function. By virtue of the fact that the thickly furred tail, hanging straight down below the branch, lowers the animal's center of gravity considerably, it serves to steady the tree kangaroo as it climbs. The tail also functions as a kind of rudder in the long leaps the tree kangaroo makes from branch to branch or from the branches to the ground. Leaps from one branch to a lower one by tree kangaroos have been estimated at up to 30 feet, and tree kangaroos have been reported to leap as much as 60 feet from a branch to the ground without injury. Another change is that the claws on the forepaws have become larger and stronger for holding onto branches and the bark of tree trunks. As in the other kangaroos, the forepaws are still used to take hold of food; in the wild they are used to pick leaves and fruit, and the Zoo's tree kangaroos use them to pick up the apples, sweet potatoes, corn-on-the-cob, and other vegetable foods on which they are fed.

Although the tree kangaroos progress by means of typically kangaroo-like hops when moving along wide horizontal branches and when on the ground, the hind legs and hind feet have become smaller relative to the forelimbs than they are in the other kangaroos. They are equipped with rough-skinned, cushion-like soles to prevent slipping. As in the other kangaroos, the second and third toes of the hind feet are fused; but each still has a separate claw. These two claws form a kind of comb which the animal uses to groom the fur of its flanks, back, and head in an amusing but quite efficient manner.

One interesting trait of the tree kangaroos is that the hair on the nape of the neck grows in a reverse direction. Apparently this enables the animal to shed water during tropical rainstorms if it sits with its head lowered in the slouching posture the Zoo's tree kangaroos so often assume. This rain-shedding device provides particularly important protection when the tree kangaroo is sleeping. Reportedly nocturnal in the wild, tree kangaroos sleep during the day with the body bent so far forward that the head is tucked between the hind legs.

Like the Zoo's tree kangaroo group, tree kangaroo breeding units in the wild are composed of a single adult male, several adult females, and young offspring in the pouch or recently emerged from the pouch. However, regrettably little is known of the breeding biology of any of the *Dendrolagus* species. For instance, in spite of the fact that several of the species have bred in zoos, the exact length of the gestation period has not been determined for any of them. National Zoo scientists have estimated the gestation period for Matschie's tree kangaroo at about 32 days. This estimation is based on the fact that one of the Zoo's females was observed mating with the male on March 8, 1971, and 32 days later was seen carefully cleaning her pouch. Since pouch-grooming prior to birth has been observed in many other kangaroo genera and since the female showed such other signs of impending parturition as an apparent desire for solitude, it is believed that she gave birth within 24 hours of the time when she was seen cleaning her pouch. Thirty-two days — while, of course, very brief compared to the gestation periods of placental mammals — is about the length one might expect for the gestation period of tree kangaroos. In five species of wallabies similar in size to the tree kangaroos, the gestation period ranges from 28 to 38 days.

The National Zoo started its tree kangaroo colony with one male and two females in May of 1970. On July 12, the male was observed mating with one of the females; and she apparently gave birth that August, although at the time the birth went unnoticed. Starting in late October, the female began cleaning her pouch several times a week, sometimes placing her entire head inside it as she did so. This behavior seemed to indicate that she had a joey, so keepers watched closely for further signs. By December, movements of the joey in the pouch were frequently observed, and the pouch had begun to sag noticeably. However, when a keeper attempted to feel for the presence of a joey with his hand, the mother was able to contract the pouch so that it appeared empty.

By the middle of January, 1971, the joey produced a swelling about the size of a baseball. It was almost two months later that its tail — which at the time was about six inches long and unfurred — was seen protruding from the pouch; a month later a fully furred leg was seen thrust out of the pouch. By May the infant was often seen putting its head and two thirds of its body out of the pouch and eating some solid food. During June it began to leave the pouch and return at will. When it was a year old, the young tree kangaroo spent most of its time outside of the pouch but still entered it to nurse. At the end of September, it was still nursing occasionally; but it was too large to re-enter the pouch and put only its head in to nurse.

That infant proved to be a female, as was the next tree kangaroo born at the National Zoo, the mother of which was the second of the original two females. The first-born female is now an adult herself. She was observed mating with the male on November 27th and 28th, 1972; so, by now, she should have a joey in the pouch. The other current joey was born to the female that gave birth to the Zoo's second-born tree kangaroo; this female can be distinguished by the fact that she had more white on her ears than the other females.

The development of both of these infants should parallel that of the Zoo's first-born tree kangaroo joey, although the older one seems to be putting its head out of the pouch at an earlier age than that joey did. With this infant growing rapidly and another infant in the Zoo-born female's pouch, visitors to the Lion House in the next several months should be able to observe simultaneously two different stages in the growth of the young of this fascinating species.

ZOO NEWS

Mammals



One of the Zoo's muntjac (*number 3c on map*).

Muntjac Fawns

In November a female muntjac was born to one of the three adult females in the Zoo's herd (*number 3c on map*). The fawn was born outdoors in the muntjacs' yard, where she remained motionless for approximately the first 24 hours of her life. Then, as soon as she was able to walk, she was led by her mother into the house at the rear of the enclosure where she remained for about three weeks. Thereafter the fawn could sometimes be seen following her mother about the yard; her coat was spotted with white as it was for the first two months of life.

Muntjac are an unusual and rather primitive group of very small deer characteristic of the forests of east and southeast Asia. The male's antlers are short and relatively incon-

spicuous; although, like the antlers of larger deer, they are grown and shed each year, the hair-covered pedicels on which they grow are as long as the antlers themselves and protrude from the forehead year round. The females too, although they do not grow antlers, have vestigial bony knobs on their foreheads. The adult male that is the Zoo's herd sire and the father of the latest-born fawn is carrying a fully developed set of antlers at this writing.

Although the antlers may sometimes play a minor role in fights among male muntjac at mating season, the males rely much more heavily in these combats on their greatly elongated canine teeth. These conspicuous tusks, which the animal can evidently move to some extent, may also come in handy in defense against predators. The somewhat smaller tusks found in the female are probably used primarily for defense.

Muntjac are sometimes known as "barking deer." Their alarm calls are surprisingly loud and similar to the barking of dogs. Similar vocalizations probably serve other functions as well; perhaps for instance, they preserve spacing among muntjac in the wild. One of the Zoo's females barks virtually every evening shortly after dark, and this behavior may suggest a spacing function.

The National Zoo currently has nine muntjac in its herd, four males and five females. Six of these, including three females and three young males, were born here to two different mothers. The elder of these two females (which can be distinguished by a white spot on her forehead) is the mother of the November fawn and also of the other breeding female. This second breeding female, incidentally, gave birth to another female fawn on January 3, 1973.

Giant Panda News

As many National Zoo visitors have discovered, the Zoo's two giant pandas (*number 10 on map*) are asleep for much of the day. On most mornings when the weather is good, the pandas are active in their outdoor yards between about 8:00 and 9:00 a.m. They are fed at 9:30 and continue to be active until about 11:00. Then they sleep until between an hour and an hour and a half before their 4:00 p.m. feeding. Given this long midday nap, it was with great interest that National Zoo scientists recently learned that the pandas are quite active at night.

Friends of the National Zoo volunteers were called on to determine exactly what Hsing-Hsing and Ling-Ling do after Zoo closing time. Observations were made on the amount of time the pandas spend sleeping, playing, feeding, and scent-marking during the night. The pandas turned out to be a good deal more active at night than had previously been suspected, and when zoologists collated the data they discovered some interesting patterns.

Both animals tended to have their activity peak between 9:00 p.m. and 1:00 a.m., but the male ("Hsing-Hsing") tended to wake up earlier. He ate mainly between 6:00 p.m. and 11:00 p.m., whereas the female ate mainly between 10:00 p.m. and 2:00 a.m. As regards play, on the other hand, the two animals were remarkably synchronized; between 10:00 p.m. and midnight both Hsing-Hsing and the female, Ling-Ling, spent a large amount of their time playing. It was found, however, that the male scent-marked with the glands under his tail far more frequently than the female did; he had not been expected to scent-mark so frequently nor the female to scent-mark so infrequently.

Incidentally, analysis of recent data has brought another new fact about the pandas to light. It seems that when the pandas are in their outdoor yards between 8:00 and 9:00 a.m. on most mornings, both of them are spending increasing amounts of time near the wire-mesh fence that separates their two enclosures. It is impossible at present to determine what effect this apparent preference for each other's company will have on the pair's chances for breeding success when they reach sexual maturity; but it is a fact that the male has shown a marked increase in the tendency to seek out the female in the past two months and that he seeks her out twice as frequently as she does him.



Some nocturnal behavior on the part of the giant pandas (*number 10 on map*).

Lesser Panda Cubs

It will be of interest to regular Zoo visitors to know that the lesser panda cubs born here last June are regularly visible. It was expected that the cubs, a male and a female, would frequently emerge from their den by the time they were two months old; but, in fact, a much longer time elapsed before the two were to be seen in the lesser pandas' enclosure (*number 16 on map*) with any regularity. The colder weather — approximating that in the lesser panda's high-altitude homeland — and the absence of large crowds of visitors in the winter are probably additional reasons, besides the cubs' age and increasing self-confidence, for their greater visibility.

The cubs are now identical to their parents in coloration, but they are smaller and a great deal more frisky. Until recently, they were most frequently seen in close association with their mother; but now they are seen with their father or by themselves much more frequently than before. The reason for this change seems to be that the cubs are being weaned. At the lesser pandas' 8:30 a.m. and 3:30 p.m. feeding times, the cubs can often be seen eating such solid foods as apples and bamboo. Keepers are watching closely at this crucial period of the young animals' lives to make certain that, once the pair are fully weaned, their father's parental tolerance is not replaced by an attempt to eject them from his territory as he would do with any other adult lesser pandas.



One of the Zoo's two lesser panda cubs (*number 16 on map*).

Bear Mothers

As this magazine goes to press, females of three species of bears are believed likely to give birth this winter. In addition, the female European brown bear (*Ursus arctos*) gave birth on January 12th. This female ("Anna") has

given birth to ten litters — a total of 26 cubs — since 1960. She has been sequestered in an inner den at the rear of the European brown bears' enclosure (*number 25a on map*). The practice of confining the mother — as is done with most expectant female bears at the Zoo — is in keeping with a wild bear mother's habit of retiring to a den in order to give birth and ensures that the cubs are safe from possible attack by the male. Anna's cubs, which number two or three per litter, have always been born between the 10th and the 16th of January; and by February, Zoo visitors should be able to hear this year's cubs' high-pitched vocalizations emerging from the den.

It is believed that both female polar bears (*Thalarctos maritimus*) and, quite possibly, a female sloth bear (*Melursus ursinus*) and a female spectacled bear (*Tremarctos ornatus*) are also pregnant. The female polar bears' possible pregnancies have necessitated some unusual rearrangements in the bear den area; one has been moved to the cage (*number 25j on map*) usually occupied by the American black bear "Smokey." The front of the cage has been boarded up and the sidewalk in front of it blocked off in order to ensure that the expecting polar bear ("Snowstar") is not disturbed. The other female is meanwhile being kept in the cubbing den at the rear of the polar bear cage (*number 25d on map*).

Sloth bears, which are native to forested areas in India and Ceylon, have bred well at the National Zoo in the past; in fact, the male of the Zoo's current pair was born here in 1966. The female, however, was received in August, 1971; and if she gives birth this year, it will be the first time for her. She has been placed in an enclosure separate from the male's (*number 18d on map*) and provided with straw bedding for her cubbing den. A birth of one of these unusual bears is always interesting because of their unique form of maternal care; the young frequently ride on the mother's back, clinging to her long fur.

The spectacled bear is the only South American bear, and many authorities believe that it may be an endangered species in the wild. Once common in forests throughout the Andes chain, it is now apparently limited to Ecuador and Peru. The National Zoo's female (*number 25g on map*) is a young animal. She arrived as a young cub in 1965 and has reached sexual maturity only recently. If she gives birth this year, it will be the first time this species has produced offspring at the National Zoo and one of a very small number of births in the world's zoos.

Rat Kangaroos

New at the Lion House (*number 23 on map*) are a pair of long-nosed rat kangaroos (*Potorous tridactylus*). These tiny kangaroos, located on the floor of the cage the upper portion of which is occupied by two-toed sloths, join the tree kangaroos, parma wallabies, and wombats to form a diverse and interesting assemblage of marsupials on exhibit in that building. The female of the pair of rat kangaroos was formerly on exhibit at the Small Mammal House; she was moved to her new quarters when a mate was acquired for her this past November.

Also known as potoroos, long-nosed rat kangaroos were once common in damp and swampy areas on the southeast coast of Australia; through the agency of introduced predators, they have nearly been exterminated on the Australian mainland. They are still fairly numerous on Tasmania, however. In the wild potoroos are nocturnal, sleeping during the day in nests of grasses and leaves built in shallow holes dug in the ground. They emerge only after dark and spend the night traveling on well-worn trails through the underbrush, stopping occasionally to feed on roots, tender leaves, and fruit. The Zoo's pair likewise sleep most of the day in the nest-box that has been provided for them; in the later afternoon, however, they are frequently active.

This genus is one of the most primitive in the kangaroo family. The hind legs and feet are not as developed as in some of the other terrestrial kangaroos, and potoroos frequently progress on all four feet rather than by means of the typical kangaroo hops and leaps. Some accounts have stated that they "gallop" quadrupedally when pursued. Still another primitive characteristic is that they do not use the forepaws to take food to the mouth as frequently as the other kangaroos do.

Young Gorilla Sent to Bronx Zoo

Mgeni-Mopaya, the gorilla born in May, 1972, at the National Zoo was sent on loan in late January to the Bronx Zoo. The reason Mopie, as the male infant was nicknamed by its keepers, was sent away after a short time on exhibit at the Small Mammal House was that the Bronx Zoo has a young gorilla born in October with which he will be raised. Mopie's own mother was unable to raise him, and it is believed that his chances of growing into a normal gorilla adult will be far greater if he is

given a companion of his own species as soon as possible.

Princess Dies

The National Zoo's beloved lioness, "Princess," died on January 3rd. Princess had been at the National Zoo since 1953 and had given birth to 25 cubs by her mate Caesar, who died in 1968. There are no plans to replace Princess until after the remodelling of the Lion House that is scheduled to inaugurate the Zoo's new Master Plan. Another sad loss was the accidental death of one of the two orangutan twins born here in December, 1971.





The burrowing owls are located at the Bird House (number 5 on map).

Burrowing Owl Breeding Success Continues

The Zoo's adult pair of burrowing owls (*Speotyto cunicularia*) hatched their first clutch of eggs in late June, 1972. No sooner were these four young owls grown than their mother laid another clutch, consisting of five eggs, which hatched on November 6th. These five young were themselves removed from the enclosure to off-exhibit quarters in mid-December, when yet another clutch, consisting of six eggs, was found in one of the burrow nests in the owls' cage at the Bird House (number 5 on map). These eggs hatched in mid-January, and the young owls were expected to be highly active and visible a month later.

This species, famous for its habit of nesting in burrows abandoned by other animals, is found throughout Central and South America, in Florida, and in the Western United States. There are a number of subspecies; one of these — the western U.S. race — is listed as endangered by the Department of the Interior. Owls of this race are most frequently found in abandoned burrows on

the outskirts of prairie dog towns. Unfortunately, as prairie land is increasingly used for agriculture, the prairie dog towns are disappearing and with them the burrowing owls. The rodents have often been poisoned and their burrows sealed, while feral cats have preyed on the owls and further decreased their numbers.

Black-Necked Swan Cygnets

Three black-necked swans (*Cygnus melancoryphus*) were hatched at the waterfowl ponds (number 30c on map) on January 17. The downy gray young could swim directly after hatching, but one or more could often be seen riding on its mother's back or, occasionally, on its father's back. The cygnet — as the young of swans are called — would climb up to this position without assistance from the parent. When the young reach the age of three or four months, their grayish plumage will be shed and replaced by the black neck, white body, and red bill of the adult.


ZOOMAP


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2. Connecticut Avenue vehicular entrance
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7. Raptor cages (a-d)
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10. Panda House (a-c)


11. Elephant House
12. Water birds (a-e)
13. Hawks and owls (a-c)
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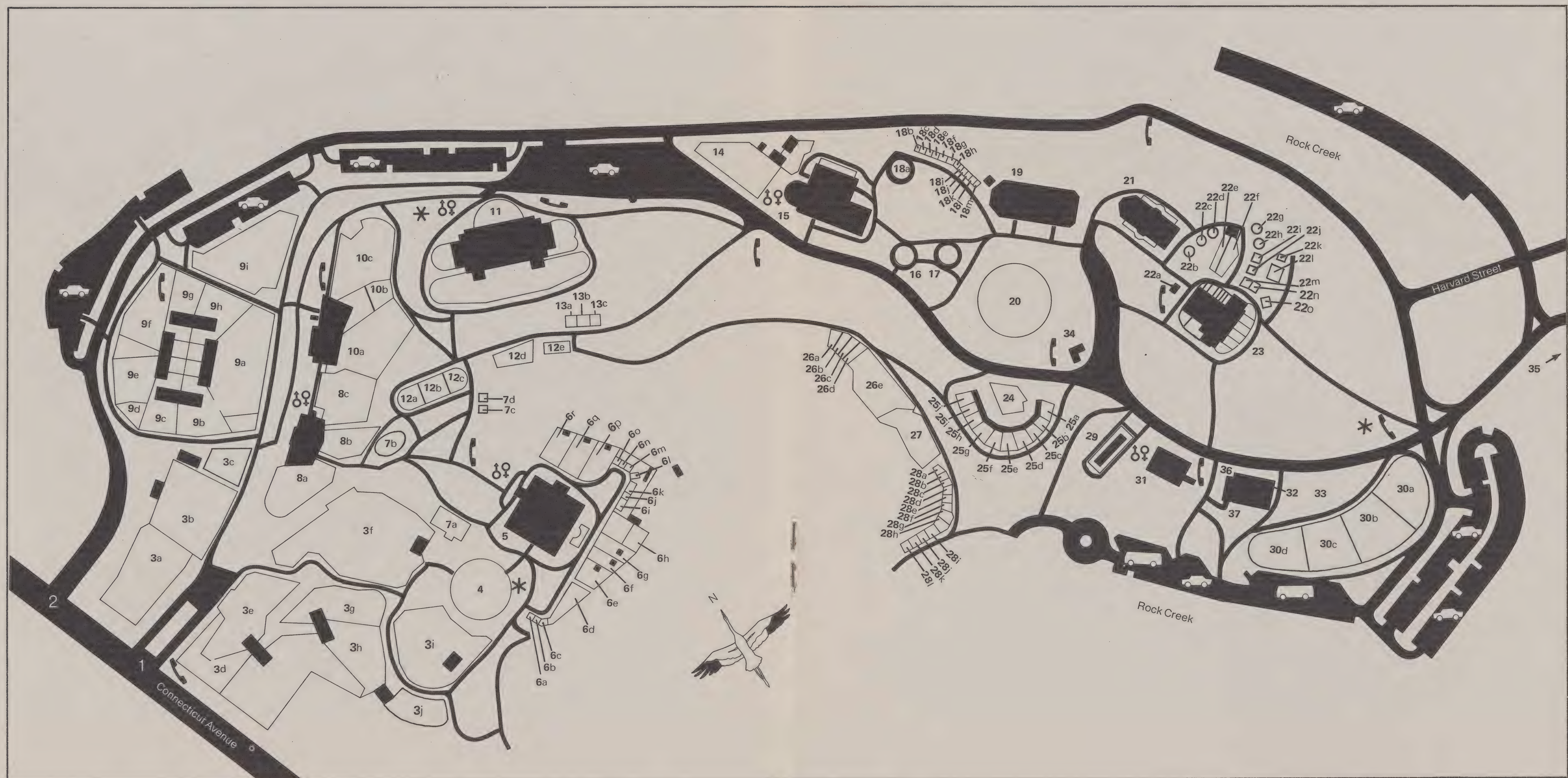
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Lesser Green Broadbill Exhibit

Cage 18 at the Bird House (*number 5 on map*) has been liberally festooned with Spanish moss in hopes that the lesser green broadbills (*Calyptomena viridis*) there will nest. The female was observed showing an apparent interest in gathering nesting materials; so members of other non-terrestrial species were quickly removed from the exhibit, and the Spanish moss was added on the theory that it would provide an excellent material from which to construct one of the elaborate hanging nests for which this Bornean and Malaysian species is famous.

The broadbill's nest is a pear-shaped structure woven out of leaves, grasses, mosses, and vines and suspended from a branch; hanging from the bottom of the nest there is also a streamer or "tail" that may be three feet long. Usually the nest hangs over water, and it is hoped that the running water in the Zoo's broadbills' enclosure will provide an added stimulus for nesting.

The broadbills are a family of fourteen species of birds of the tropical forests of the Old World. They are considered the most primitive family of the great order of perching birds (Passeriformes), which contains some 5100 species — well over half of all known species of birds. Most broadbills are insectivorous; but the lesser green broadbill and other members of its genus feed mainly, or perhaps exclusively, on fruit.

Lesser green broadbill at the Bird House (*number 5 on map*).



A male giant pitta puffs out his feathers as an aggressive gesture.

Giant Pitta Nest

Visitors to the Indoor Flight Room at the Bird House (*number 5 on map*) will notice on their left just as they walk through the front door of the room a large pile nest on top of a tree stump. This nest was built by a pair of giant pittas (*Pitta caerulea*). These are relatively large ground-dwelling birds; the male is turquoise on his back, wings, and tail, and has an off-white breast, while the female's back and wings are brown and only her tail feathers turquoise. Unfortunately, for reasons that are not entirely clear, the nesting attempt seems at present to have been unsuccessful. But there is still hope that the birds will breed successfully, if not this year then next year; and much interesting behavior apparently associated with breeding can still be observed.

There are two giant pitta males in the Indoor Flight Room, one of which formed a breeding pair with the female and helped her build the nest. This male (which is somewhat larger and is banded on his left leg) was also once seen mounting the female. At times the other male would approach or even enter the nest; and, when the proprietor male returned, there would frequently be spirited chases

along the ground near the nest. Even now, when the two males meet, they exchange agonistic signals. The paired male puffs out his breast feathers and often bows low, in profile to the other male. The other male also puffs out his breast feathers but continues to stand upright. The one male's bowing is not submissive but in fact constitutes the more aggressive threat of the two postures, as can be deduced from the fact that it resembles the position the bird would assume if about to attack the other bird.

The sequence of behavior associated with breeding on the part of the giant pittas began when the female laid a broken egg on the ground. Then the nest-building started; and it appeared as if all was going well until one morning an African black crane (*Limnocorax flavirostra*) was found on the nest. For several days thereafter, the pittas stayed away from the nest, apparently frightened off by the intruder. Later they again returned to the nest and exhibited new forms of behavior that seemed to indicate breeding success was imminent. For instance, the male of this ordinarily silent species was heard calling for the first time. His call was a beautiful clear whistle; and the female, feeding in another part of the room, would often return his call. Then, suddenly, the calling ceased, and the birds began to frequent the nest less and less.

So perhaps we will have to wait till next fall for a successful breeding of this interesting species. But zoo visitors can still see the pitta's large, apparently disorderly nest, constructed just as it would be in the lowland forests of Sumatra and Borneo, and notice the carefully concealed entrance that leads down into its spacious inner chamber.

New Waterfowl Exhibit

New exhibits at the waterfowl ponds, due to be installed by February 15, initiate the Zoo's revitalized interpretation program. The highlights of the new exhibits are six colorful panels (*number 30a on map*) illustrating the vital interconnection that has existed between man and members of this unique family of birds for thousands of years and something of the birds' own fascinating biology.

Graphics will illustrate the manifold interdependences of man and waterfowl in the areas of art, recreation, economics, and conservation. An historical panel will illustrate the legend of the sacred geese in Juno's temple at Rome that saved Rome from attack by

means of their alarm calls. A replica of a seal from the reinternment robe of the 7th century, A.D., St. Cuthbert will be accompanied by a description of his role in the establishment of the first bird sanctuary in the modern sense, and a reproduction of an 18th dynasty Egyptian fresco of a waterfowl hunt will show the role these birds played in both the economy and the art of that ancient civilization.

One panel will illustrate the wild progenitors of our domestic waterfowl — the mallard duck and the greylag goose — and some of the many varieties that man has produced from these ancestral species by selective breeding, while others tell the story of man's commercial overexploitation of waterfowl and the eventual conservation measures that saved this great natural resource from destruction. One species mentioned is the Hawaiian goose or néné, which is represented in the Zoo's collection. This species, while not yet entirely assured of survival, has been increased from a mere handful primarily through breeding in zoos and private collections. The National Zoo, incidentally, hopes to aid in this world-wide effort; and its nénés have laid eggs this winter.

An added touch will be a series of five beautifully carved and hand-painted sculptures detailing the mating procedures of the mallard duck. These postures can be observed every spring on the Zoo's waterfowl ponds among the wild mallards that stop there; analogous rituals — many with interesting variations suggestive of complex evolutionary relationships — can be observed among the more exotic waterfowl in the Zoo's collection. The artist who produced these sculptures, Mr. Jonathon Jones of St. Petersburg, Florida, has also made smaller carvings for all of the identification labels in the waterfowl area (*number 30a-d on map*). These will be enclosed in five plexiglass cases, which will be transparent on all sides so that, while looking at the label, Zoo visitors will be able to look through the back of the case and locate the bird it identified on the pond.

Reptiles and Amphibians



Smokey jungle frog at the Reptile House (*number 19 on map*).

New Frog Exhibits

Two new species of frogs are on exhibit in the F Section of the Reptile House (*number 19 on map*). One is the large smokey jungle frog of South America (*Leptodactylus pentadactylus*). Sometimes called “South American bullfrogs,” these frogs are actually not closely related to the true bullfrogs; they are mainly terrestrial, often living in well-marked dens. The other new species is the Cuban tree frog (*Hyla septentrionalis*); native to Cuba and the West Indies, this species has been introduced into southern Florida. Like other tree frogs, they have suction cups on their toes which enable them to cling not only to tree trunks but also, as the Zoo’s four frequently demonstrate, to glass or metal.

In addition, a bullfrog tadpole exhibit has been added to the F section. Bullfrogs remain in the tadpole stage a good deal longer than most other frogs; it usually takes 14 to 16 months for a bullfrog tadpole to metamorphose into an adult, and it may take three

years. The Cuban treefrog, on the other hand, lays its eggs in temporary pools of water, and it has had to evolve a much quicker development. Interestingly, recent evidence suggests that in amphibians the ability to metamorphose quickly is associated with relatively small amount of DNA — the chemical carrier of genetic information — in the nuclei of the cells.

The smokey jungle frog further illustrates the diversity of means of reproduction that characterizes the frogs and toads. Members of this species lay their eggs in frothy bubble nests. When the young hatch, they eat the nest and it provides valuable nourishment for them.

■ The Great Indian Rhinos



The great Indian one-horned rhinoceros (*Rhinoceros unicornis*) is one of the rarest of all large mammals. There are perhaps as few as 250 members of this species still existing in the wild in India and Nepal, and there are only about 50 of them in the world's zoos. The National Zoo is fortunate to have an adult pair; and it is with great pleasure that the Zoo is able to report that its Indian rhinos appear to have bred successfully this past September. In accordance with the Indian rhino's phenomenally long gestation period, a birth is expected in late January 1974.

As recently as the Middle Ages, the Indian rhinoceros was found in much of the northern half of the Indian subcontinent and as far east as Indochina. Gradually it was exterminated in most of this range as a result of two factors. One was increased human settlement and cultivation of the alluvial plains that seem to have been the Indian rhino's preferred habitat. In addition, the rhinos have been persecuted for centuries because of the role played by various parts of their bodies — particularly the horn — in magic and folk medicine. The latter pressure increased markedly with the arrival of firearms in the last century and gave rise to a fantastically lucrative com-

merce in rhinoceros products that, in spite of protective measures, continues to this day.

The world's four other rhinoceros species have suffered diminution for similar reasons, and none of them can be considered entirely free from danger. The African black rhinoceros (*Diceros bicornis*) has fared best, with some 12,000 individuals surviving in well-protected parks. One of two races of the African white or square-lipped rhinoceros (*Ceratotherium simum*) is adequately protected, while the other is still in a precarious position. The trade in rhino horn has always centered in the Far East, and thus it is to be expected that it has had a more devastating effect on the Asiatic species. It is probably too late to save the Javan rhinoceros (*Rhinoceros sondaicus*), the closest living relative of the Indian rhinoceros. This species was once found throughout Indochina, Sumatra, and Java; but now only about two dozen survive in the Ujung-Kulon Reserve in Java. The Sumatran rhinoceros (*Didermoceros sumatrensis*) once shared the Javan rhino's range and was also found in Borneo. Unique in that it is the only present-day rhinoceros whose body is covered with hair, it remains in only a few isolated pockets in Sumatra, Malaysia, Burma, and Thailand; but it is





unclear exactly how many animals there are or what their chances are for survival.

It was during the Eocene epoch, between 55 and 35 million years ago that the first known member of the rhinoceros family appeared. Although it was hornless, this odd-toed ungulate had in other respects the typical rhinoceros body form. Later, a great variety of rhinoceros species evolved, including the woolly rhinoceros of northern Eurasia, which was portrayed in human cave paintings but had died out before the end of the last Ice Age. The genus to which the Indian rhinoceros belongs can be traced back to the Miocene epoch between 25 and 10 million years ago. But the antiquity of the rhinoceros family and the fact that a great many species died out before the end of the Ice Ages do not mean that the rhinoceros as a group would have faced extinction today without human interference. On the contrary, there is every indication that the five species that have survived into our own geological epoch would have continued to prosper indefinitely were it not for needless destruction of their habitat and needless persecution for superstitious reasons.

In appearance, the Indian rhinoceros probably represents to most people more of an echo of the antiquity of the rhinoceros line than any other rhinoceros species. Its skin, divided into section by large folds, has the look of armor-plating; there are even flat circular lumps in the skin that might be taken either for rivet-heads or for chain-mail. Moreover, the impression that this is a creature from the distant past is greatly augmented by the fact

that, whereas photographs of the African rhinoceros species on their natural habitat are relatively common, few people have seen or photographed the Indian rhinoceros or any of the other Asiatic rhinoceroses in their native habitat.

There are apparently only two substantial populations of the Indian rhinoceros remaining in existence, one in the Indian state of Assam and one in Nepal. The larger of the two is that located at the Kazaringa Wildlife Reserve in the Indian state of Assam, which in 1966 was estimated at 400 animals but which has apparently declined since then. Intense effort is being made to protect the rhinos in this reserve, but poaching has still not been entirely eliminated. The second largest population is the one found at the Chitawan Rhino Sanctuary in Nepal; in 1966, this was estimated to contain 165 animals. However, the most recent investigator, in 1970, estimated that both these populations taken together totaled no more than 250 animals.

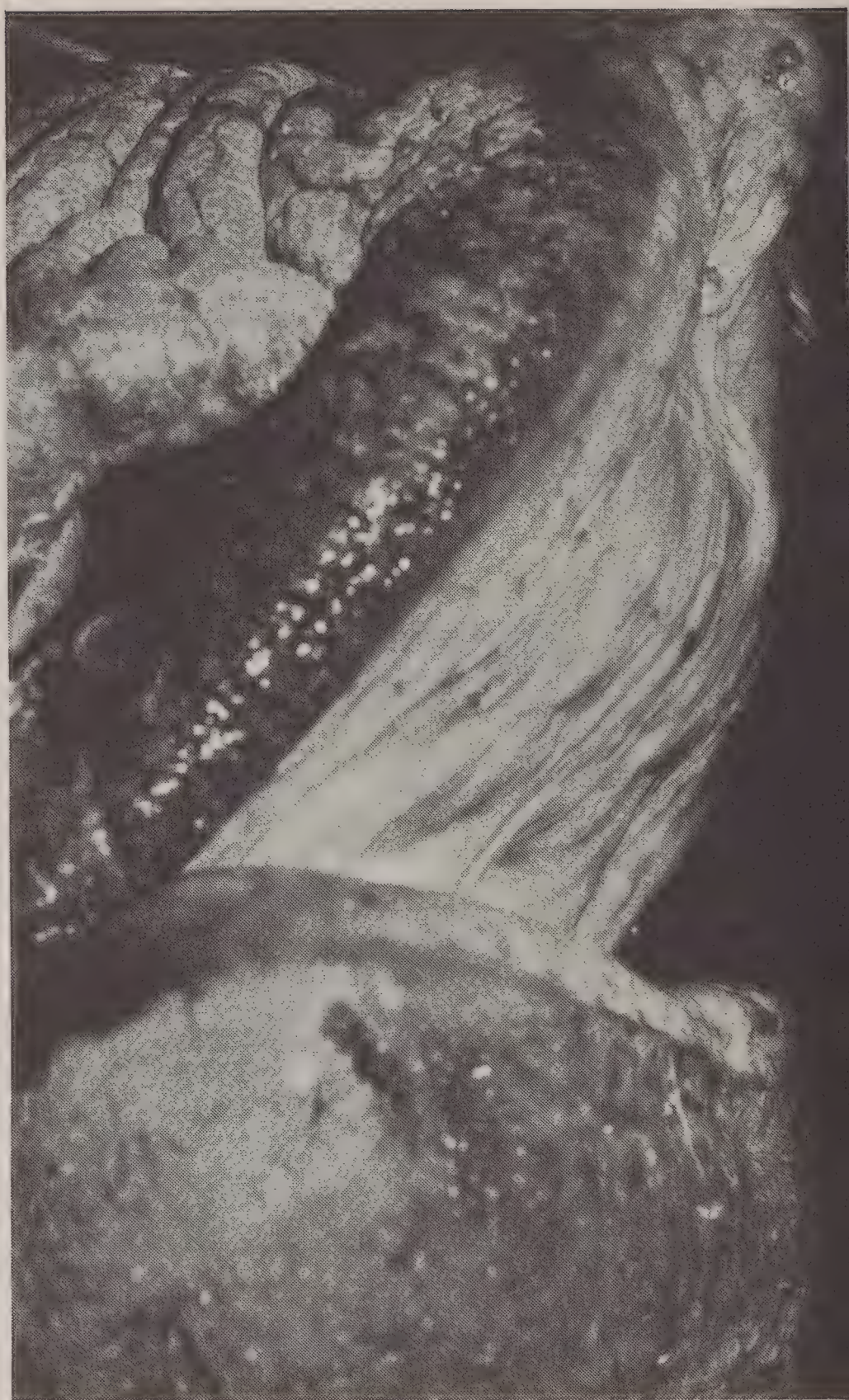
Several scientists have visited Kazaringa in recent years and have gathered valuable notes on the ecology and behavior of the Indian rhinoceroses there. Its habitat in this reserve is marshland to a large extent, as it apparently is in the few other areas where the species is still found. Although, given its fondness for baths and its well-attested ability as a swimmer, the Indian rhinoceros is evidently more dependent on water than either of the two African species and was probably always found close to rivers, its restriction to marshland is believed to be relatively recent.

It has most likely retreated to the marshlands because they are the only acceptable habitat for Indian rhinos that has not been taken over by human settlement. All rhinoceroses are animals neither of open grassland nor of really dense forests and are most commonly found in areas that combine grassland with some trees and bushes and it is probable that the Indian rhinoceros was originally found in a variety of such habitats alongside water-courses.

Actually, the Indian rhino's habitat in the Kazaringa offers a balance between permanent swampland and a certain amount of steppe and forest. The more characteristic vegetation is the six- to fifteen-foot-high elephant grass, on which the rhinos rely for cover in time of danger and which also constitutes a large percentage of their diet. Alternating with the elephant grass are more open pasturelands, where shorter grasses and various marsh plants grow. The rhinos feed on this vegetation also to a certain extent. Finally, there are scattered bits of forest in the reserve, where rhinos can also occasionally be found. The life of the Indian rhinoceros in the Kazaringa is further complicated by seasonal floods that inundate much of the area, forcing the rhinos to migrate to the foot of the Mikir Hills to the south of the reserve. That is a region where rice and tea are cultivated, and there the rhinos unfortunately sometimes come into conflict with human settlers.

Except for flood-times, the Kazaringa rhinos lead a remarkably regular life. They sleep from midnight till early morning, usually concealed in the elephant grass. Then they move by well-trodden trails to grazing areas, where they feed for about two hours more. Wallowing in mud, a habit the Zoo's Indian rhinoceroses share, doubtless provides a protective coating against external parasites. Around mid-day, the rhinos return to their resting places, where they sleep at least three hours. On waking they again find suitable feeding grounds and remain there until midnight.

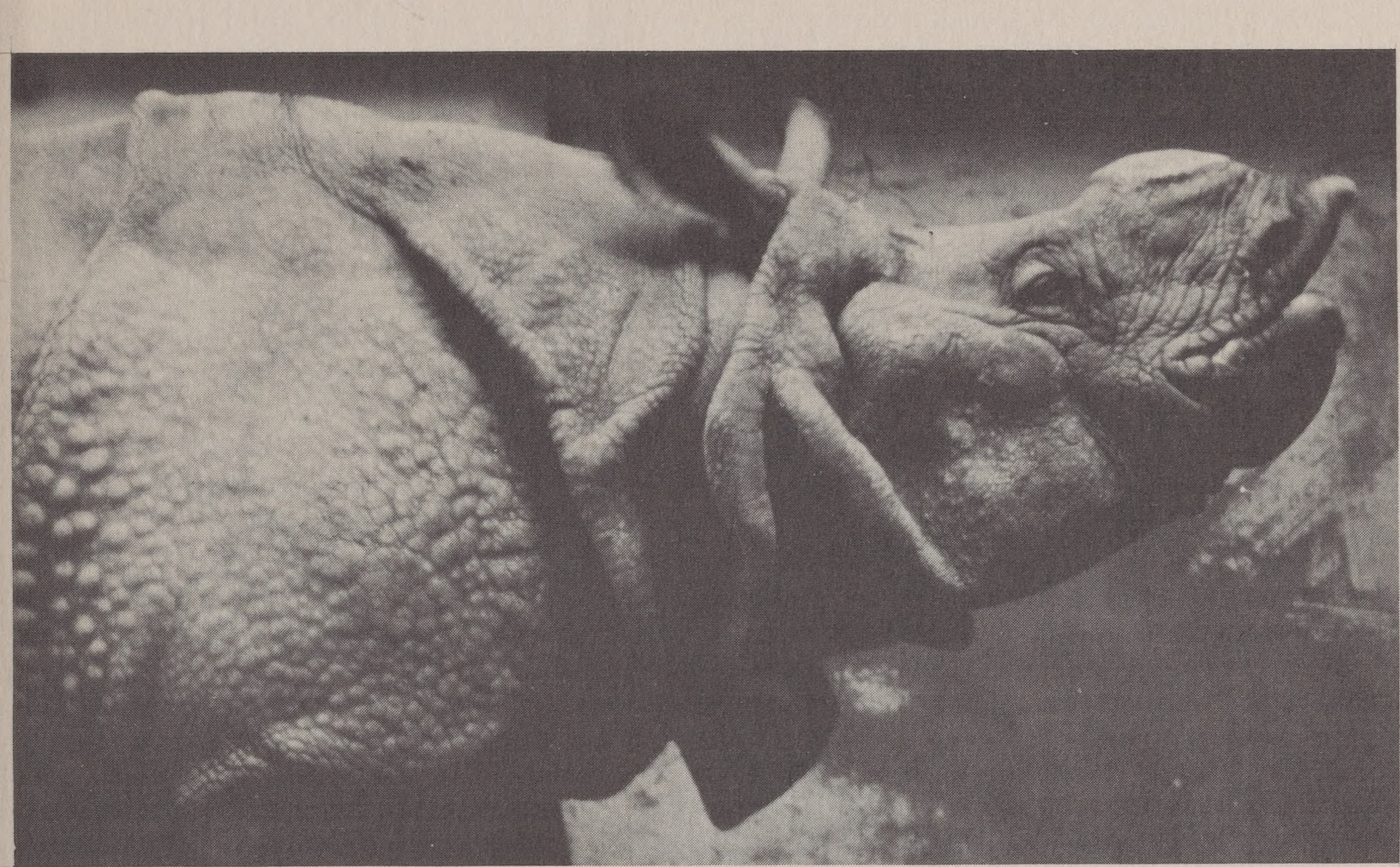
In general, members of all rhinoceros species are not very sociable animals. Adults, especially adult males, are frequently solitary. The only really strong social grouping that is ever found is a small matriarchal grouping — numbering up to seven individuals in the Indian rhinoceros — consisting of an adult female and other rhinoceroses to which she has given birth in the past. If these are males, they are probably less than nine years old —



These two photographs illustrate “Flehmen” — the exaggerated lip-curl shown by a male Indian rhinoceros when he sniffs an estrus female's urine.

the age at which the male reaches sexual maturity. If they are females, they may have young of their own, which are also members of the group. When the matriarch is near giving birth, she drives away her previous offspring, which is then between one-and-three-quarters and three years old. But when her new calf is about one-half grown, the mother may be rejoined by several of her previous offspring.

Two or more matriarchal groups will sometimes come together temporarily in grazing areas, at bathing sites, or at mud wallows and share the area in peace; these temporary aggregations may number up to 20 animals. The only other type of social bond that is seen in this species is the temporary bond that exists between a male and female that are mating. Fully adult males are rarely seen together, and two adult males that meet will usually show aggressive signals, such as violent snorting, until one of the two flees.



Each solitary bull Indian rhinoceros defends a private grazing territory about an acre in area and also defends a private sleeping place. Some authorities believe that solitary adult females defend similar territories; whether or not matriarchal groups also do so is unclear. On the other hand, bathing places and wallows are never private property, and rhinos intermingle there. When territorial male rhinos meet at these places, they snort at each other but soon settle down to bathe or wallow together peacefully. Most of the paths through the elephant grass are public and open to all rhinos, but the paths that branch off these public paths and lead to the private sleeping and feeding territories are private and are defended against intruders.

Each group and each solitary individual tends by and large to keep out of the way of other groups and individuals; they are able to do so primarily by means of olfactory communication. Large dung piles on the well-worn public rhino trails are used by each individual as it passes; thus it keeps other rhinos that come along the same trail later informed about who has passed that way. Such a dung pile — which may be as high as three feet in the center and may extend outwards to a radius of four or five feet — apparently offers an irresistible stimulus to every passing rhino; and it has been reported that even when pursued by hunters an Indian rhinoceros would stop at every dung pile it encountered during its flight. Solitary bulls

also sometimes leave olfactory signals in the form of urine, which they spray horizontally backwards onto grasses and other plants.

In addition, adult females mark by spraying urine horizontally when they are in estrus, at which time the marking doubtless serves to alert males to their location and their condition of breeding readiness. The estrus female also signals her condition by means of a high-pitched whistle which can carry for a considerable distance. Moreover, in the wild the estrus female Indian rhinoceros wanders away from her usual home range in search of a mate.

There is a breeding season in the female Indian rhinoceros during which she comes into estrus approximately every 46 to 48 days although the interval may occasionally be as short as 38 days or as long as 58 days. Each of these estrus periods lasts about 24 hours. One observer believed that the breeding season generally occurs in the spring in the Kazaringa Reserve; captive females have come into season at a variety of other times of the year in a variety of zoos. In the Basel Zoo in Switzerland the female has also come into breeding condition in the spring. In both the Delhi Zoo and our own National Zoo, females have come into breeding condition during late summer and early autumn. The male comes into breeding condition in response to the presence of a female in estrus.

The breeding behavior of the Indian rhino-

ceros has been little observed in the wild; but a considerable amount of data is available from zoos — including, now, the National Zoo. At most zoos, adult pairs of Indian rhinoceroses are kept separate except when the female's behavior indicates a possibility of mating. When admitted to an estrus female's enclosure, the male reacts with several characteristic forms of behavior. One of these is vigorous chasing or "driving" of the female; females evidently also chase males at times. Another is a facial expression usually referred to by the German word "Flehmen." Flehmen, which appears in courting males of a great many mammalian species, consists of sniffing the estrus female's urine and curling the lip in a distinctive exaggerated fashion. The lip-curl apparently makes it possible for the scent of the female's urine to reach Jacobson's organ, a cavity lined with olfactory mucus membranes and connected with both the nasal cavity and the oral cavity, that is presumably sensitive to the chemical composition of the estrus female's urine.

The National Zoo's male Indian rhinoceros ("Tarun") is 14 years old and has been here since May of 1960; the female ("Rajkumari") is nine years old and was received in December, 1963. Female rhinoceroses first enter breeding condition at the age of about five years; and the Zoo's female was first placed with the male at that age on July 1st, 1968. The male drove the female but made no attempt to mate. The first clear breeding behavior was observed in August, 1970, when the male mounted the female briefly on two occasions but without successful copulation. A year later considerable breeding activity was observed, including one mounting that lasted ten minutes, during which partial intromission and external ejaculation were observed.

Consequently, as the time of year during which these attempts had taken place approached again in 1972, it was hoped that at last a successful breeding might occur. On July 11, 1972, the pair were placed together for the first time since December, 1971; and, in subsequent days, they were kept together for most of the day but separated at night. On July 13, the male chased the female around the enclosure, but the female did not develop full estrus that month. On August 11, when it was again believed that the female was coming into estrus, the rhinos were put together at night; and arrangements were made for Friends of the National Zoo

volunteers to observe their nocturnal behavior and summon the scientist in charge of the Indian rhinoceros breeding program, in the event of any breeding activity.

At 6:50 p.m. on August 12th, the first breeding attempt of the season took place; and during the next 20 hours, the male mounted the female some 30 times. The male failed to achieve full intromission, however, and none of the mountings lasted longer than ten minutes. Many observers have commented on the difficulty the male Indian rhinoceros often has in achieving intromission once he is mounted. Because of his great bulk and because of the fact that the erect penis is over three feet long and curved forward at the tip, considerable rather awkward maneuvering is often required before successful copulatory position is achieved.

On September 23rd, 41 days after this period of unsuccessful but intense breeding activity, the female first showed signs of the onset of a new estrus. She was active throughout the night, pacing continuously for long periods along the wall or the bars of the cage. The following morning she had a very high temperature over her entire body, probably as a result of the exercise. For three days she continued her nightly activity, wandering between her indoor and outdoor enclosures and bathing frequently in her outdoor pool. By the third day, her temperature had returned to normal. Evidently this period of great restlessness corresponded to the reported wandering of the female Indian rhinoceros at the time of estrus in the wild.

Many of the signs that indicate that a female Indian rhinoceros is in estrus have been observed in zoos. Among these are urinating horizontally backwards, whistling, opening and closing or "flashing" the vulva, backing into the male, and placing the head between the male's hind legs. During Rajkumari's period of nightly restlessness, however, she showed none of these signs. The only clear indication of an estrus condition was a dark amber-colored urine the morning after her first night of activity. Then, on the morning of September 29, she flashed her vulva briefly after urinating normally; and she twice raised her tail over her back as a female Indian rhinoceros is reported to do when urinating horizontally. At 5:30 a.m. on September 30, she backed into the male, pressing him against the wall of the cage. At 6:35 a.m., both rhinoceroses went outside quite suddenly, and mounting began. The male

easily achieved intromission and remained mounted from 6:40 to 7:50 a.m., during which time there were numerous ejaculations, as indicated by strong pelvic movements. In another captive pair of Indian rhinoceroses, 56 ejaculations were counted in a 60-minute-long mounting; and many have pointed out that this breeding pattern is the likely reason for what is probably the most widespread, persistent, and destructive of folk beliefs about rhinoceroses — namely, that rhinoceros horn is of value as an aphrodisiac.

After the male dismounted, the female returned to her indoor enclosure and made some vocalizations, including a high-pitched squeak. This sound was believed to be related to the female Indian rhino's well-known whistle, but the Zoo's female never produced a really distinct whistle. No further mounting occurred, and the animals rested the better part of the next 24 hours. They were active, however, for brief periods and frequently in physical contact with each other both while resting and while active. In November, a watch was begun again in order to determine whether or not the female would again come into estrus. There were no signs of estrus — a good indication that the September breeding had indeed been successful and that she was pregnant. If there is a birth without complications, it will be the first viable birth to have taken place in any Zoo in North America.

The first Indian rhinoceros birth in captivity took place on September 14, 1956, at the Basel Zoo. Since then, eleven more have been born in Basel and eight in other zoos. The gestation period has been measured at between 462 and 489 days. The calf, born while the mother is standing and in a time of only 15 to 30 minutes, is pink in color at birth. Its skin has the folds and protuberances of the adult's; but the horn is not present yet, and there is a smooth oval plate where it will appear later. The calf is able to stand on its feet and follow its mother after about the first hour-and-a-half of life.

The great Indian rhinoceros is one of relatively few endangered animal species which have a clear chance of being saved from extinction by breeding in zoos. Successes over the past fifteen years indicate that breeding this species in captivity should soon become a routine matter. Then, when a large number of captive-born animals are being produced, it should be possible to re-introduce some of them to the wild in protected reserves in parts of this species once-extensive range. The National Zoo is proud to be involved

in the effort to save these unique and spectacular animals; and some of the Indian rhinoceroses that, with luck, will be born here in future years will hopefully contribute to re-established populations of this species in the wild.

The Zoo's two Indian rhinoceroses are located at the Elephant House (*number 11 on map*).

